



**Certified Wireless Network Administrator (CWNA)
PW0-106**

Chapter 12
WLAN Troubleshooting



Chapter 12 Overview

- Layer 2 Retransmissions
- 802.11 Coverage Considerations
- Voice vs. Data
- Performance
- Weather
- Upper layer troubleshooting

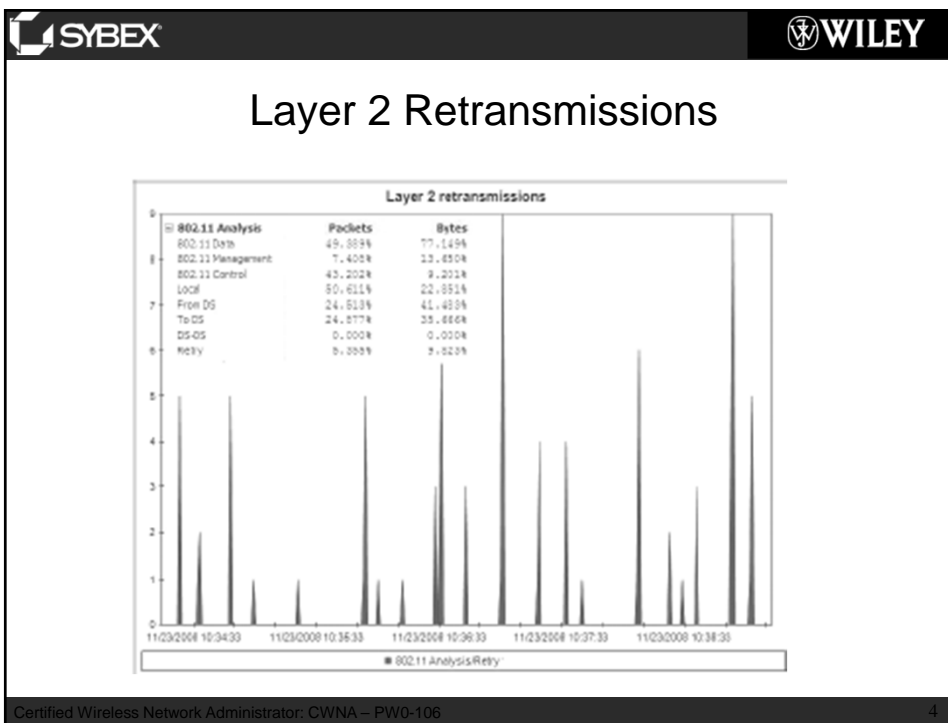
Certified Wireless Network Administrator: CWNA – PW0-106

SYBEX **WILEY**

Layer 2 Retransmissions

- Retransmissions occur when the sending STA does not receive an ACK frame from the target STA
- Layer 2 retransmissions impact performance
 - Increase overhead
 - Increase latency and jitter
- Real-time applications are impacted most by retransmissions
 - All communications are slower

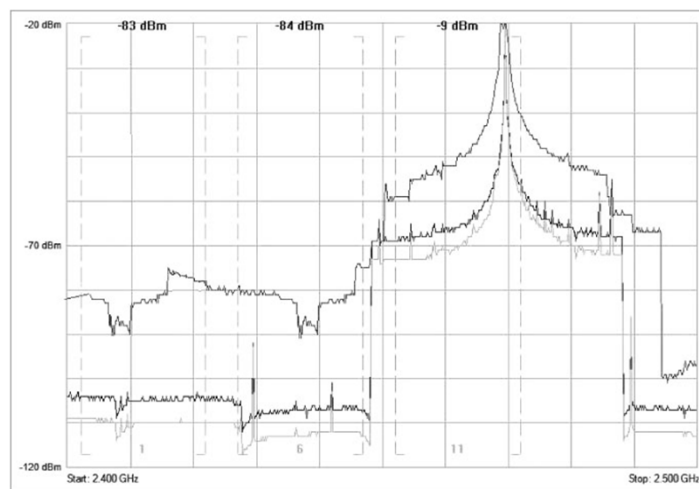
Certified Wireless Network Administrator, CWNA – PW0-106 3

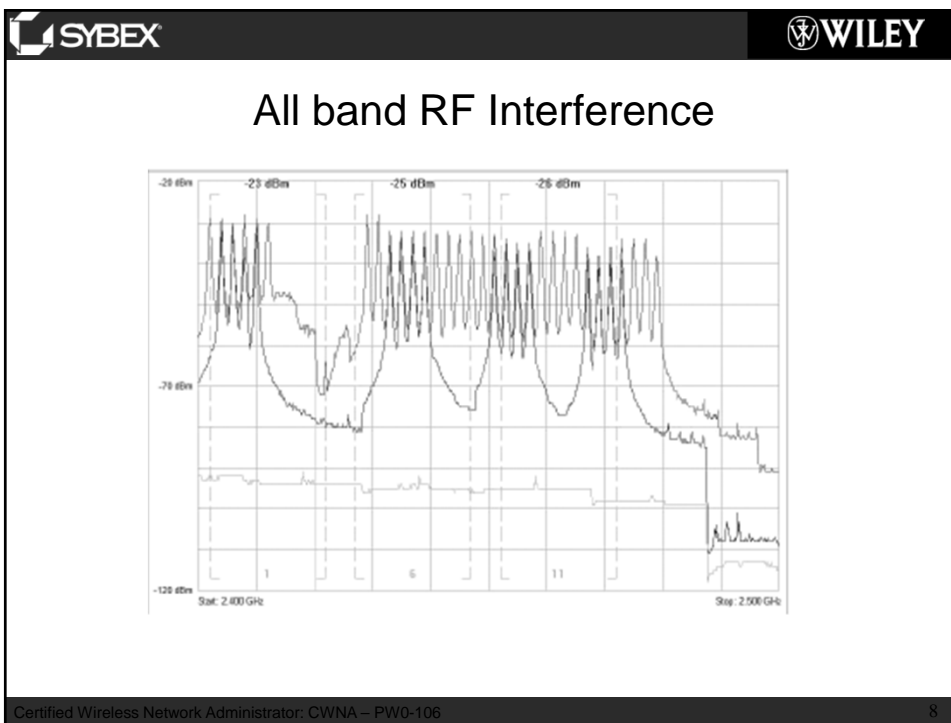
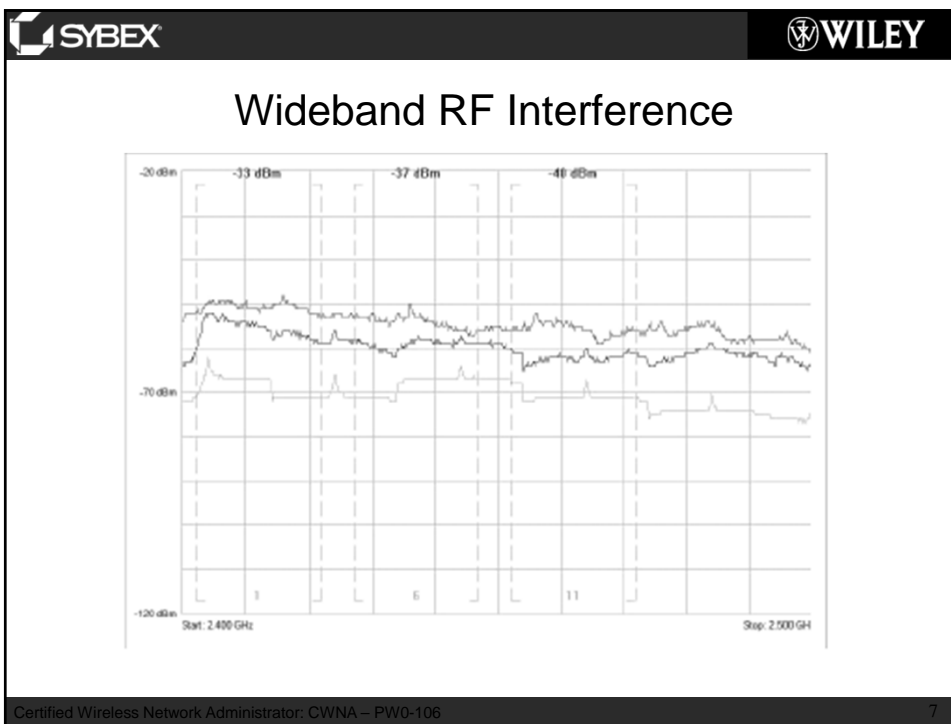


Layer 2 Retransmissions Causes

- RF Interference
- Multipath
- Adjacent Channel Interference
- Low SNR
- Mismatched Power Settings
- Near/Far
- Hidden Node


Narrowband RF Interference





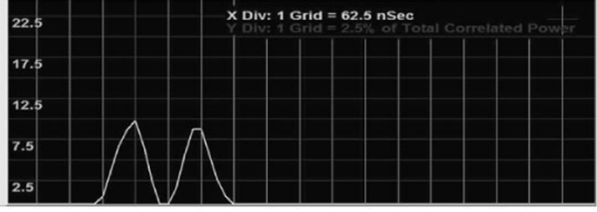
SYBEX **WILEY**

Multipath



Single MAC Address:	Ch	RSSI	STA	Type	First Seen:	Last Seen:	SSID/BSSID
00-14-D1-C3-BD-5B	6	-63 dBm	AP	DSSS	12:40:44	12:51:33	TRENDnet637

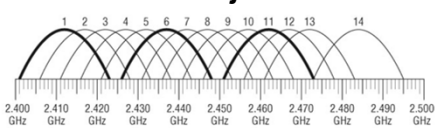
MULTIPATH DISPLAY
DELAY SPREAD
ANTENNA ALIGNMENT
TRAFFIC ANALYSIS
RSSI vs TIME
RETURN TO SCAN
Waiting For Data...



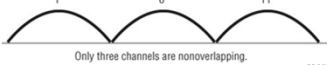
Certified Wireless Network Administrator: CWNA – PW0-106 9

SYBEX **WILEY**

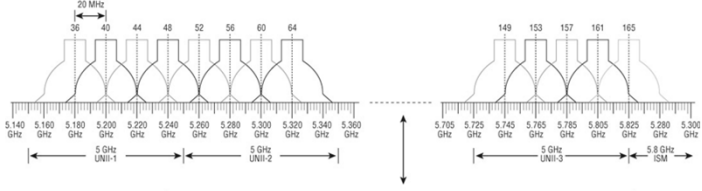
Adjacent Channel Interference



2.400 GHz 2.410 GHz 2.420 GHz 2.430 GHz 2.440 GHz 2.450 GHz 2.460 GHz 2.470 GHz 2.480 GHz 2.490 GHz 2.500 GHz

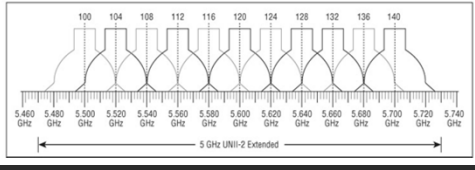


Only three channels are nonoverlapping.



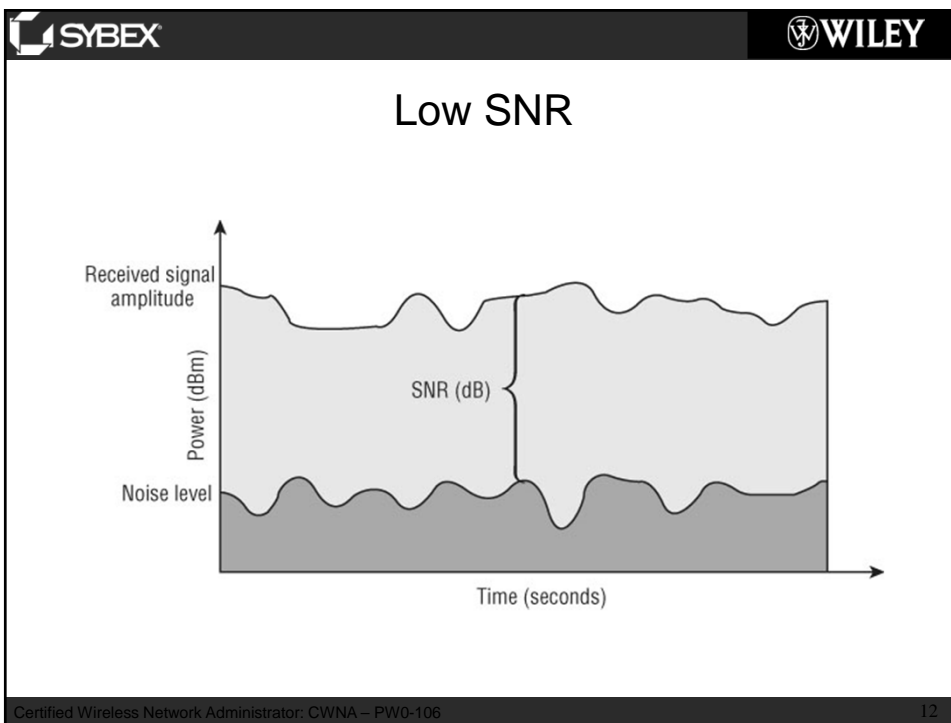
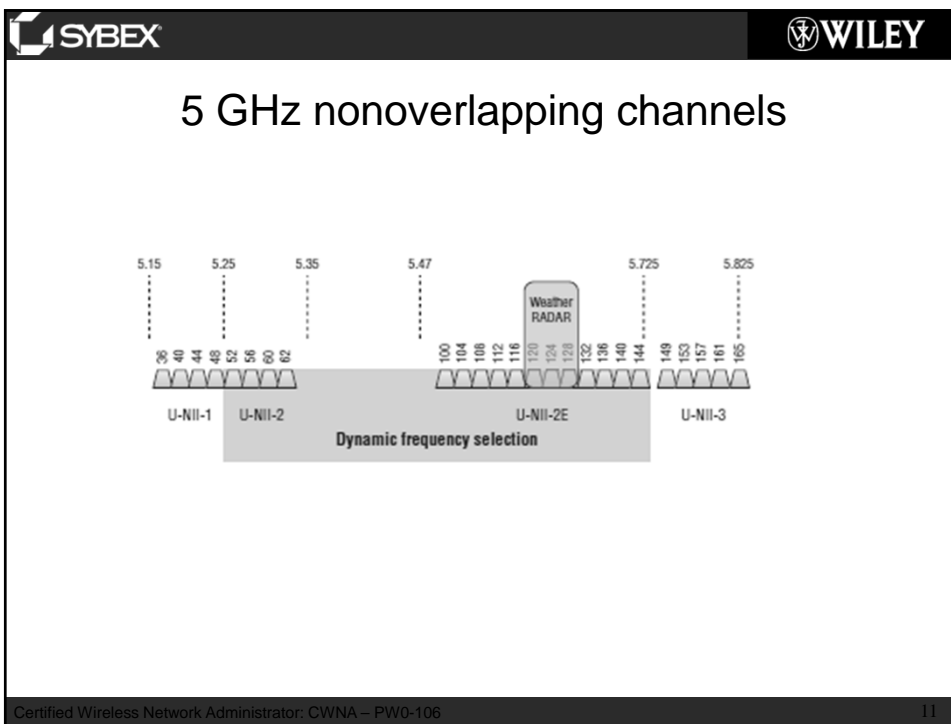
5.140 GHz 5.160 GHz 5.180 GHz 5.200 GHz 5.220 GHz 5.240 GHz 5.260 GHz 5.280 GHz 5.300 GHz 5.320 GHz 5.340 GHz 5.360 GHz

5.705 GHz 5.725 GHz 5.745 GHz 5.765 GHz 5.785 GHz 5.805 GHz 5.825 GHz 5.840 GHz 5.300 GHz



5.400 GHz 5.480 GHz 5.500 GHz 5.520 GHz 5.540 GHz 5.560 GHz 5.580 GHz 5.600 GHz 5.620 GHz 5.640 GHz 5.660 GHz 5.680 GHz 5.700 GHz 5.720 GHz 5.740 GHz

Certified Wireless Network Administrator: CWNA – PW0-106 10



SYBEX **WILEY**

High and low signal-to-noise ratio

Received signal - -70 dBm
SNR - 25 dB
Ambient noise floor - -95 dBm
Received signal - -88 dBm
SNR - 7 dB

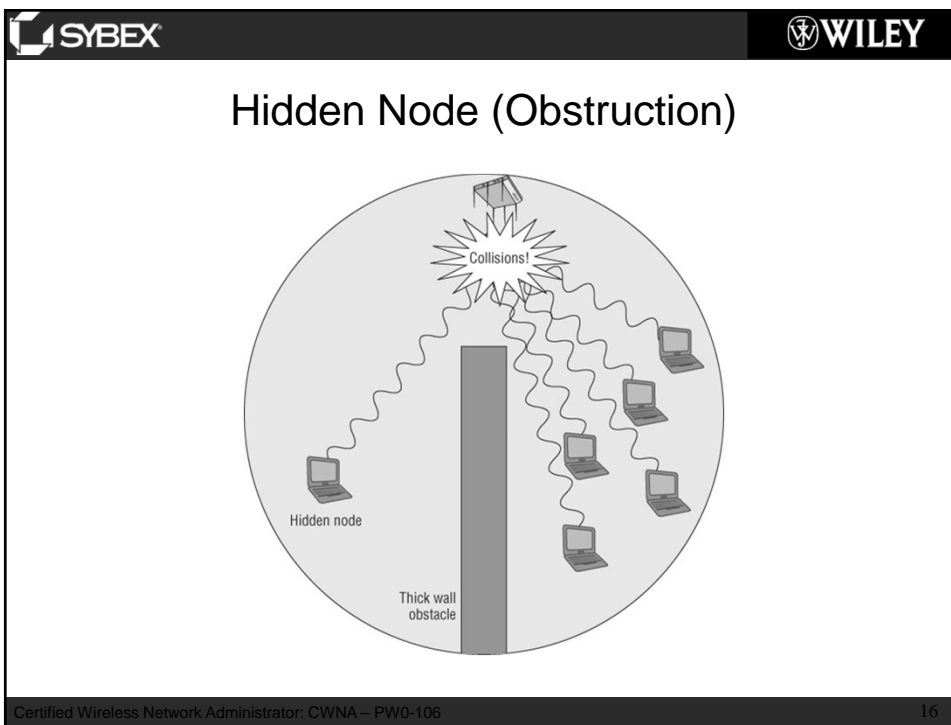
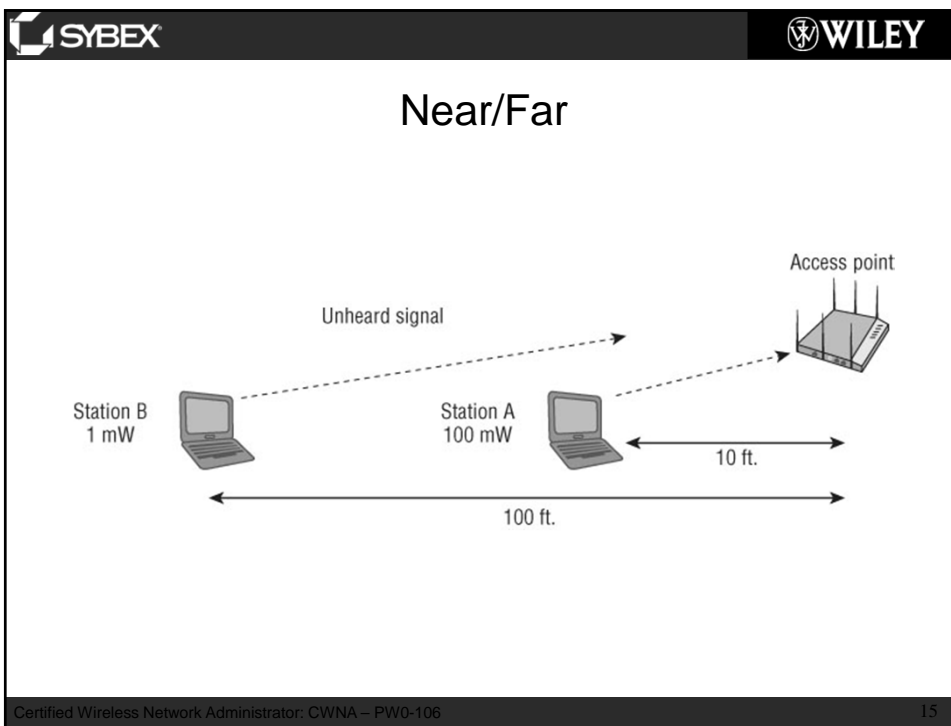
Certified Wireless Network Administrator: CWNA - PW0-106 13

SYBEX **WILEY**

Mismatched Power Settings

Unicast frame
ACK frame is heard
Unicast frame
ACK frame is not heard by the AP
20 mW coverage cell
100 mW coverage cell
AP: 20 mW
Client: 20 mW
AP: 100 mW
Client: 20 mW

Certified Wireless Network Administrator: CWNA - PW0-106 14



SYBEX **WILEY**

Hidden Node (Large Coverage Cell)

Station A and access point hear each other.

Station B and access point hear each other.

Station A and Station B cannot hear each other.

Certified Wireless Network Administrator, CWNA – PW0-106 17

SYBEX **WILEY**

Hidden Node (Distributed Antenna System)

300 ft. +

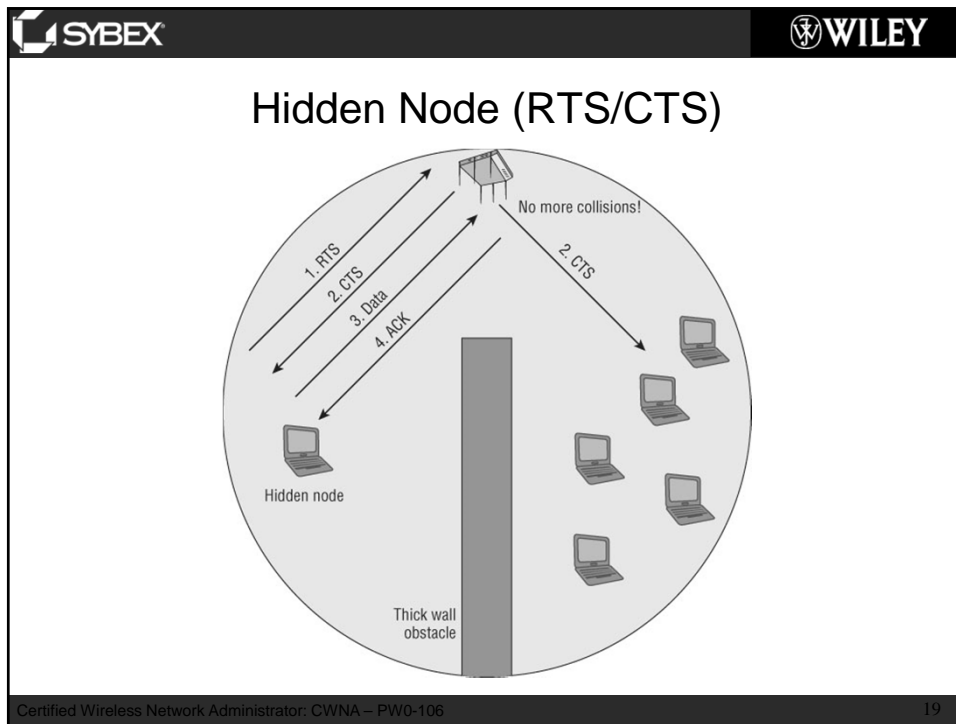
Heard signal

Unheard transmissions

100 ft. +

Access point

Certified Wireless Network Administrator, CWNA – PW0-106 18



To fix a hidden node problem

- Use RTS/CTS to diagnose
- Increase power to all stations
- Remove the obstacles
- Move the hidden node station
- Add another access point

Certified Wireless Network Administrator, CWNA – PW0-106 20

SYBEX **WILEY**

802.11 Coverage Considerations

- Dynamic Rate Switching (DRS)

Certified Wireless Network Administrator, CWNA – PW0-106 21

SYBEX **WILEY**

Data rate coverage zones

Certified Wireless Network Administrator, CWNA – PW0-106 22

SYBEX **WILEY**

Frame transmission time

1,500-byte frame - 300 microseconds

11 Mbps 5.5 Mbps 2 Mbps 1 Mbps

1,500-byte frame 3,300 microseconds

Certified Wireless Network Administrator, CWNA – PW0-106 23

SYBEX **WILEY**

Roaming

Original AP Target AP

-85 dBm -65 dBm


Reassociation request

Certified Wireless Network Administrator, CWNA – PW0-106 24

SYBEX **WILEY**

Cell overlap

Theoretical coverage cells Real coverage cells



Certified Wireless Network Administrator, CWNA – PW0-106 25

SYBEX **WILEY**

Multichannel monitoring with a single protocol analyzer

- AirPcap



Certified Wireless Network Administrator, CWNA – PW0-106 26

SYBEX **WILEY**

Layer 3 roaming boundaries

The diagram shows a central router with two interfaces: 192.168.100.1 and 10.0.0.1. Two switches are connected to the router, each representing a different network. The left switch is connected to the 192.168.100.1 interface and has a User VLAN 20 with IP 192.168.100.10. The right switch is connected to the 10.0.0.1 interface and has a User VLAN 30 with IP 10.0.0.10. A mobile client is shown moving from the left network to the right network. A dashed arrow indicates the client roams seamlessly at layer 2. Below the client, it is noted that the client must obtain a new IP address.

192.168.100.1 10.0.0.1

192.168.100.10 10.0.0.10

Client roams seamlessly at layer 2.

192.168.100.17 10.0.0.17

Client must obtain new IP address.

Certified Wireless Network Administrator, CWNA – PW0-106 27

SYBEX **WILEY**

Mobile IP

The diagram shows a Home Agent (HA) and a Foreign Agent (FA) connected to a central router. The HA is connected to User VLAN 20 (10.1.20.0/24) and the FA is connected to User VLAN 30 (10.1.30.0/24). A mobile client with a home address of 10.1.20.55 is shown moving from the HA to the FA. A dashed arrow indicates that the HA tunnels client traffic to the FA. Below the client, it is noted that the client maintains its original IP address.

Home agent (HA) Foreign agent (FA)

HA tunnels client traffic to the FA.

User VLAN 20: 10.1.20.0/24 User VLAN 30: 10.1.30.0/24

Client roams across layer 3 boundaries.

Client maintains original IP address.

Home address: 10.1.20.55

Certified Wireless Network Administrator, CWNA – PW0-106 28

SYBEX **WILEY**

Co-channel interference

2.4 GHz

The AP on channel 1 transmits.

All nearby APs and clients on channel 1 defer transmissions.

Channel 1

Channel 1

Channel 1

Channel 1

Certified Wireless Network Administrator: CWNA – PW0-106 29

SYBEX **WILEY**

Adjacent channel interference

Channel 1

Channel 4

Channel 7

Channel 7

Channel 11

Certified Wireless Network Administrator: CWNA – PW0-106 30

SYBEX **WILEY**

Channel Reuse/Multiple-Channel Architecture

- 2.4 GHz multiple-channel architecture

Certified Wireless Network Administrator, CWNA – PW0-106 31

SYBEX **WILEY**

Channel Reuse/Multiple-Channel Architecture

- Clients and co-channel interference

Certified Wireless Network Administrator, CWNA – PW0-106 32

SYBEX **WILEY**

Channel Reuse/Multiple-Channel Architecture

- An 8-channel pattern consisting of the non-DFS U-NII-1/U-NII-3 bands

Certified Wireless Network Administrator, CWNA – PW0-106 33

SYBEX **WILEY**

Channel Reuse/Multiple-Channel Architecture

- 5 GHz multiple-channel architecture

5 GHz

Distance to cell with same channel is at least two cells.

Certified Wireless Network Administrator, CWNA – PW0-106 34

SYBEX **WILEY**

Three-dimensional channel reuse

The diagram illustrates a three-dimensional channel reuse pattern across five floors (Floor 1 to Floor 5). Each floor contains three access points labeled 1, 6, and 11. The channels are reused in a staggered pattern across floors to maximize efficiency. For example, channel 1 is used at the first, third, and fifth positions on each floor, while channel 6 is used at the second position and channel 11 at the third position. This pattern repeats across all five floors.

Certified Wireless Network Administrator, CWNA – PW0-106 35

SYBEX **WILEY**

Channel Reuse/Channel Bonding

- Twelve 40 MHz channels are available to be used in a reuse pattern when deploying an enterprise WLAN.
- However, two of the twelve 40 MHz channels currently cannot be used in the United States because they fall within the TDWR band

The diagram shows the 5 GHz frequency spectrum with 40 MHz channels. Channels are labeled with their center frequencies and channel numbers. Channels 102 and 110 are blocked by a Weather Radar band. The available channels are:

Channel Number	Center Frequency (GHz)
38	5.15
46	5.25
54	5.35
62	5.47
102	5.47
110	5.47
118	5.725
126	5.725
134	5.825
142	5.825
151	5.825
159	5.825

Certified Wireless Network Administrator, CWNA – PW0-106 36

SYBEX **WILEY**

40 MHz channel reuse

The diagram illustrates channel reuse in a hexagonal cell structure. The central cell is labeled 46. Its six immediate neighbors are labeled 38, 151, 151, 38, 159, and 159. The next ring of cells is labeled 38, 151, 46, 151, 38, and 159.

Frequency allocation for U-NII-1 and U-NII-3 is shown below:

- U-NII-1:** Channels 36, 40, 44, 48 (20 MHz); Channels 38, 46 (40 MHz)
- U-NII-3:** Channels 149, 153, 157, 161 (20 MHz); Channels 151, 159 (40 MHz)

Certified Wireless Network Administrator, CWNA – PW0-106 37

SYBEX **WILEY**

Single-Channel Architecture

The diagram shows an SCA WLAN controller connected to three Channel 6 APs. Each AP is represented by a circle containing a mobile phone icon and the following information:

- Channel 6**
- Lightweight AP MAC: 00:12:17:09:84:B1
- Virtual BSSID: 00:12:17:AA:BB:CC

The three APs are connected to a laptop icon at the bottom, with the text: "The client sees only one 'virtual' AP."

Certified Wireless Network Administrator, CWNA – PW0-106 38

SYBEX **WILEY**

Zero handoff time

The diagram shows two overlapping circles representing wireless networks. Both are labeled "Channel 6" and "BSSID: 00:12:34:88:CC:DD". Each circle contains a wireless router icon. A mobile phone icon is positioned in the overlapping area. An arrow points from the phone to the right, labeled "Zero handoff time" and "00:00". The label "Channel 6" is also present at the bottom right of the diagram area.

Certified Wireless Network Administrator, CWNA – PW0-106 39

SYBEX **WILEY**

Capacity vs. Coverage

- RF coverage of a building using three APs with few wireless stations

The diagram shows a rectangular building outline. Three overlapping circles represent the RF coverage of three access points (APs). The circles are labeled "Ch 1", "Ch 6", and "Ch 11" from left to right. The circles overlap significantly, covering the entire width of the building.

Certified Wireless Network Administrator, CWNA – PW0-106 40

SYBEX **WILEY**

Cell sizing—multiple-channel architecture

Certified Wireless Network Administrator, CWNA – PW0-106 41



SYBEX **WILEY**

Band Steering to 5 GHz

2.4 GHz and 5 GHz probe requests

AP responds only with 5 GHz probe response.

Certified Wireless Network Administrator, CWNA – PW0-106 42

Band steering for frequency balancing

- Many WLAN vendors can define a percentage of clients to be directed to the 5 GHz band, with the remainder directed to the 2.4 GHz band



Band Steering
 Note: The following band steering settings will be applied to both the 2.4 and 5 GHz radios.

Enable the steering of clients from the 2.4 to 5 GHz bands

Band steering mode Balance band use

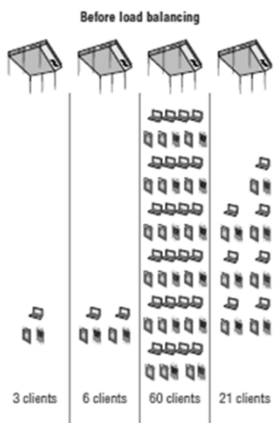
Ratio of 5 GHz to 2.4 GHz clients 50 (1-100%)

Certified Wireless Network Administrator: CWNA – PW0-106
43


Load Balancing

Before load balancing





3 clients 6 clients 60 clients 21 clients

After load balancing



22 clients 22 clients 24 clients 22 clients

Certified Wireless Network Administrator: CWNA – PW0-106
44






High-Density WLANs

Application	Required throughput
Email/web browsing	500 Kbps 1 Mbps
Printing	1 Mbps
SD video streaming	1 Mbps to 1.5 Mbps
HD video streaming	2 Mbps to 5 Mbps



- To estimate the number of devices supported on a single AP radio, divide the individual airtime required per device into 80 percent.
- $(80 \div \text{single device airtime consumption} = \# \text{ devices per AP radio})$

Certified Wireless Network Administrator: CWNA – PW0-106
45






Voice vs. Data

TABLE 12.1 IP voice and IP data comparison

IP voice 	IP data 
Small, uniform-size packets	Variable-size packets
Even, predictable delivery	Bursty delivery
Highly affected by late or inconsistent packet delivery	Minimally affected by late or inconsistent packet delivery
“Better never than late”	“Better late than never”



Certified Wireless Network Administrator: CWNA – PW0-106
46



Performance

- Transmission power rates
- Antenna gain
- Antenna type
- Wavelength
- Free space path loss
- Physical environment
- CSMA/CA
- Encryption
- Application use
- Number of clients
- Layer 2 retransmissions



Certified Wireless Network Administrator: CWNA – PW0-106 47



Weather

- Lightning
- Wind
- Water
- Air stratification
- UV/Sun

Certified Wireless Network Administrator: CWNA – PW0-106 48

Upper-Layer Troubleshooting

- Upper-layer networking diagnostic tools

VLAN Probe

Start Stop

The VLAN probe is complete.

Device * 02-A-700a40

VLAN Range * 1 to 5 (1-4094)

Probe Packet 1 (1-10)

Timeout 3 (1-60 seconds)

VLAN Probe Result

VLAN ID	Available	Subnet
1	yes	10.5.1.0/24
2	yes	10.5.2.0/24
3	no	
4	no	
5	no	

RADIUS Test

Send a RADIUS Access-Request message from the AirPrime device to a RADIUS authentication server or an Accounting-Request message to a RADIUS accounting server.

RADIUS Server* 10.5.1.10

RADIUS Client* 02-A-700a40

Network Connectivity Test

RADIUS authentication server

RADIUS accounting server

RADIUS Supplicant Credentials

Note: To test the authentication process for a valid supplicant, enter the user name and password for a user account on the RADIUS authentication server.



User Name or Barcode* user (1-32 characters)

Password or PIN* ***** (1-64 characters)

Test Result

RADIUS server is reachable. Get attributes from RADIUS server. User Attribute-ID 0=10.

Certified Wireless Network Administrator, CWNA – PW0-106
49

Chapter 12 Summary

- Layer 2 Retransmissions
- 802.11 Coverage Considerations
- Voice vs. Data
- Performance
- Weather
- Upper layer troubleshooting

Certified Wireless Network Administrator, CWNA – PW0-106
50